



Introduction to Department of Energy Conversion and Storage

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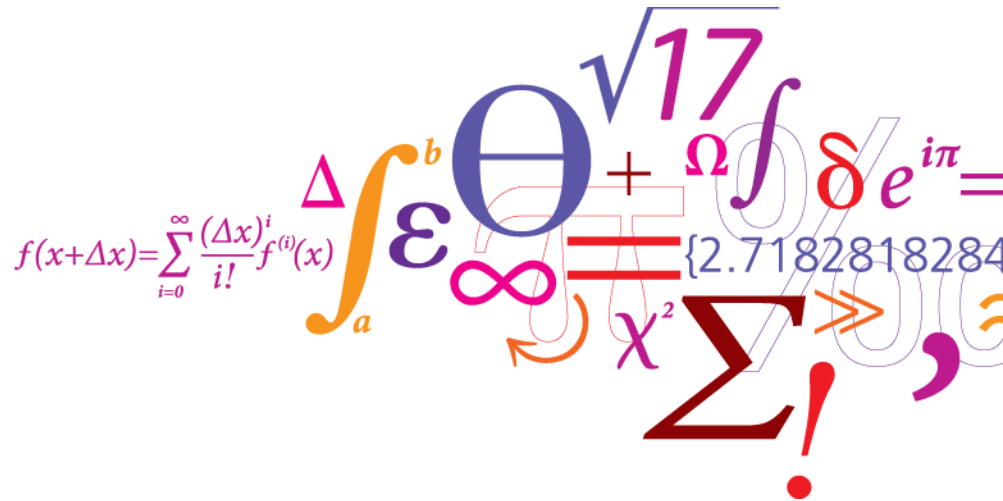
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Introduction to Department of Energy Conversion and Storage

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Technical University of Denmark (DTU)

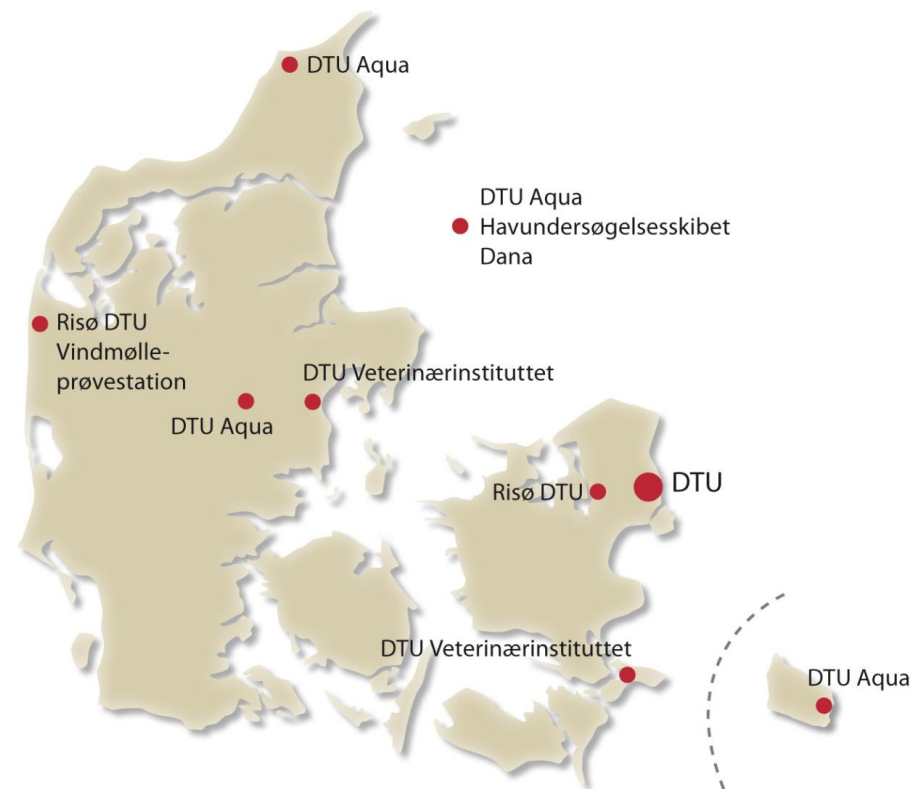


Founded in 1829 (by H.C. Ørsted)

From 1962 to 1974, DTU moved to its current location in Lyngby

- Employees ca. 4800
- Students ca. 8500
- PhD-students ca. 1200
- International students ca. 650/year
(2010)

Technical University of Denmark



Risø

1958 Founded in by Niels Bohr and others as a nuclear research institution.

1985 Nuclear power officially given up
Risø becomes *Research Centre Risø*

2007 Risø becomes part of DTU
Risø DTU National Laboratory for Sustainable Energy
ca. 700 employees

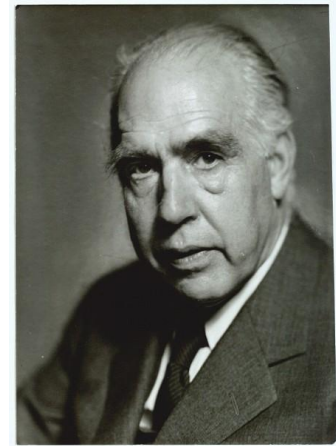
2012 DTU energy Conversion is formed:

From Risø DTU:

- Fuel Cells and Solid State Chemistry Division
- The Solar Energy Programme
- Parts of the Materials Research Division

From DTU Chemistry:

- Energy and Materials Science Group.

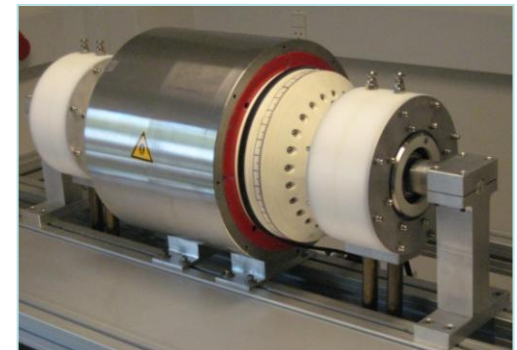
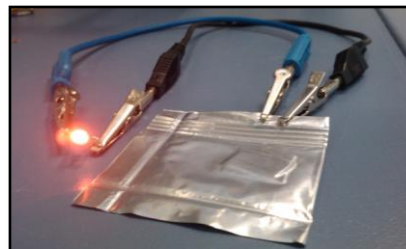
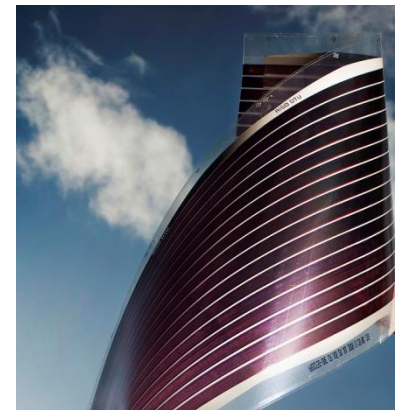


Overview of the department

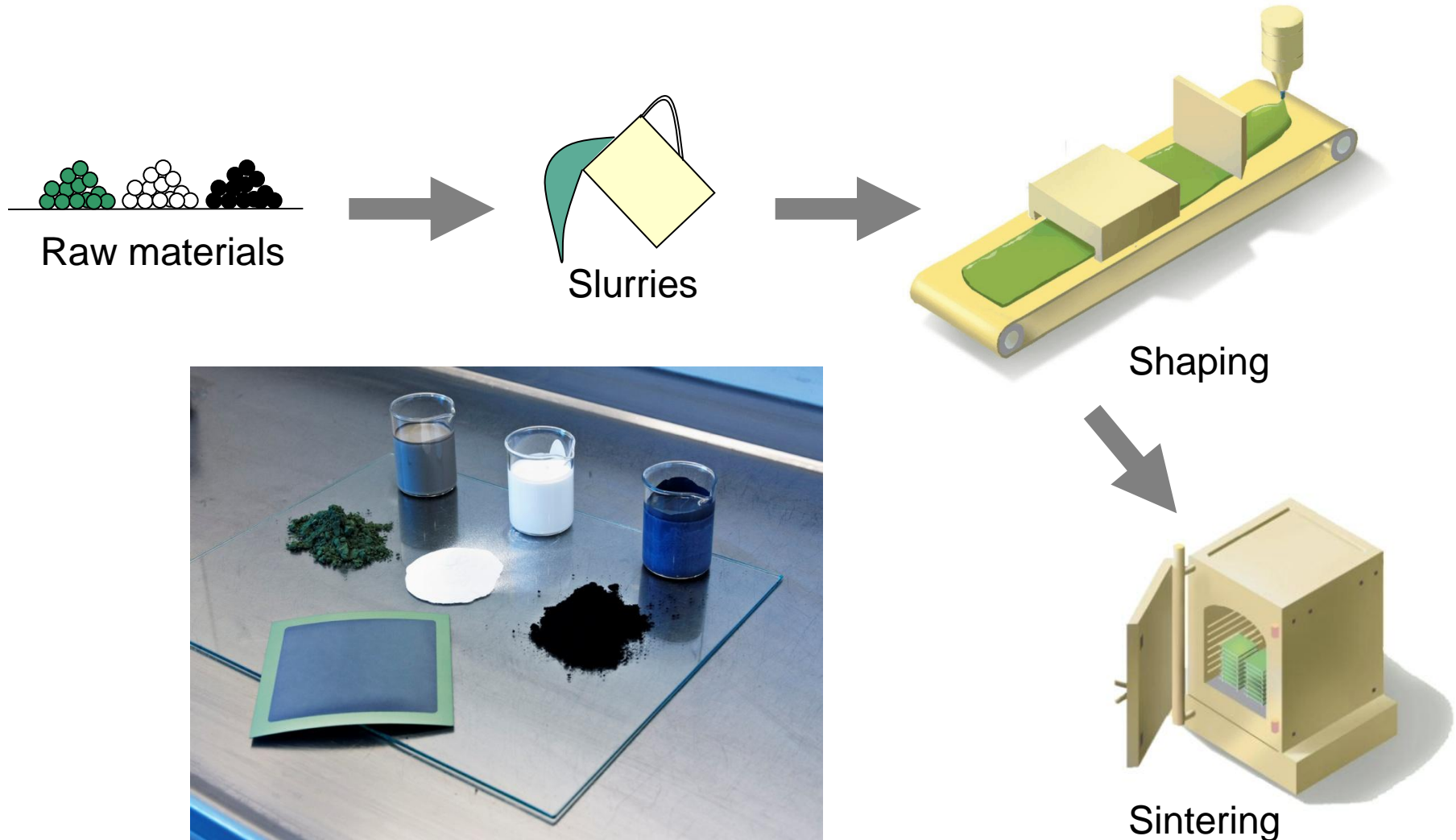
- Sustainable technologies for energy conversion and storage
- ~230 people
- Research span from fundamental investigations to component manufacture
- Focus on industrial collaboration and industrially relevant processes
- Head: Professor Søren Linderøth
- Located on two campuses: Risø and Lyngby

Technologies

- Solid oxide fuel cells
- High-temperature PEM fuel cells
- Electrolysis
- Polymer solar cells
- Batteries
- Solid state storage of hydrogen and ammonia
- Membranes for oxygen or hydrogen separation
- Magnetic refrigeration
- Thermoelectric components
- Flue gas purification using electrochemical cells
- Superconducting components



Solid Oxide Fuel Cells



Solid Oxide Fuel Cells

Pre-pilot facility



Capacity of 10,000s
of units per year

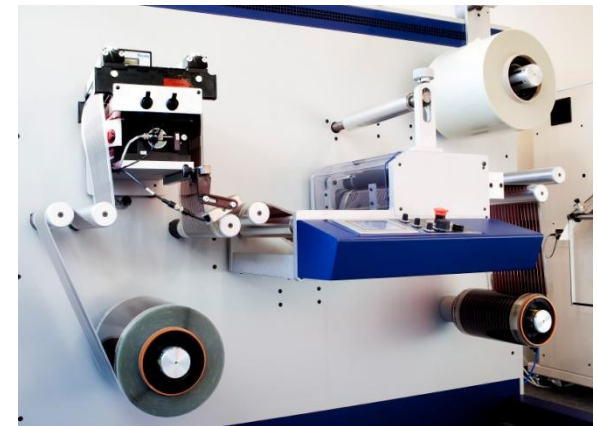
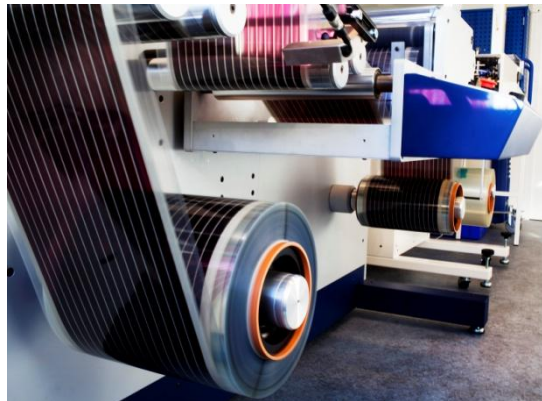
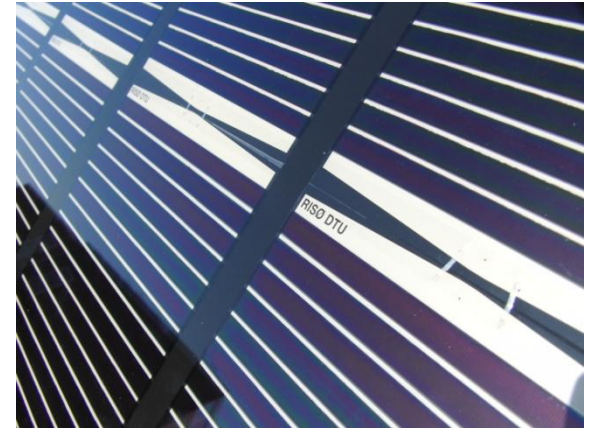
SOFC: Topsoe Fuel Cell pilot plant



TOPSOE FUEL CELL 
RETHINKING ENERGY

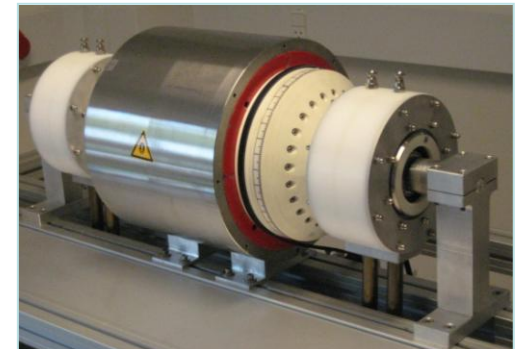
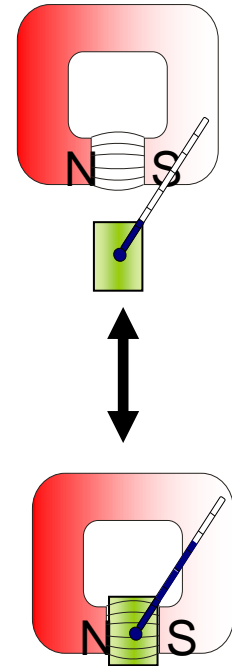
Polymer solar cells

- Promising alternative to traditional Si-based photovoltaics
- Organic photovoltaics printed on flexible plastic substrates
- High-speed roll-to-roll processing
- Research focus on increased efficiency and lifetime



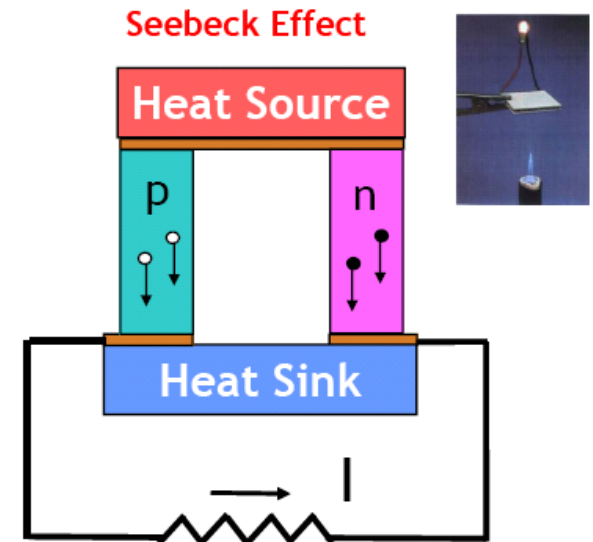
Magnetic refrigeration

- Uses the magnetocaloric effect
- Ceramic materials with tunable transition temperature
- Advantages
 - high efficiency
 - low-noise operation
 - environmentally friendly (no volatile gases)
- Both for refrigeration and heat pumps
- Prototype designed and constructed at DTU
 - 200 W cooling power @ 18 °C span
 - further optimization under way

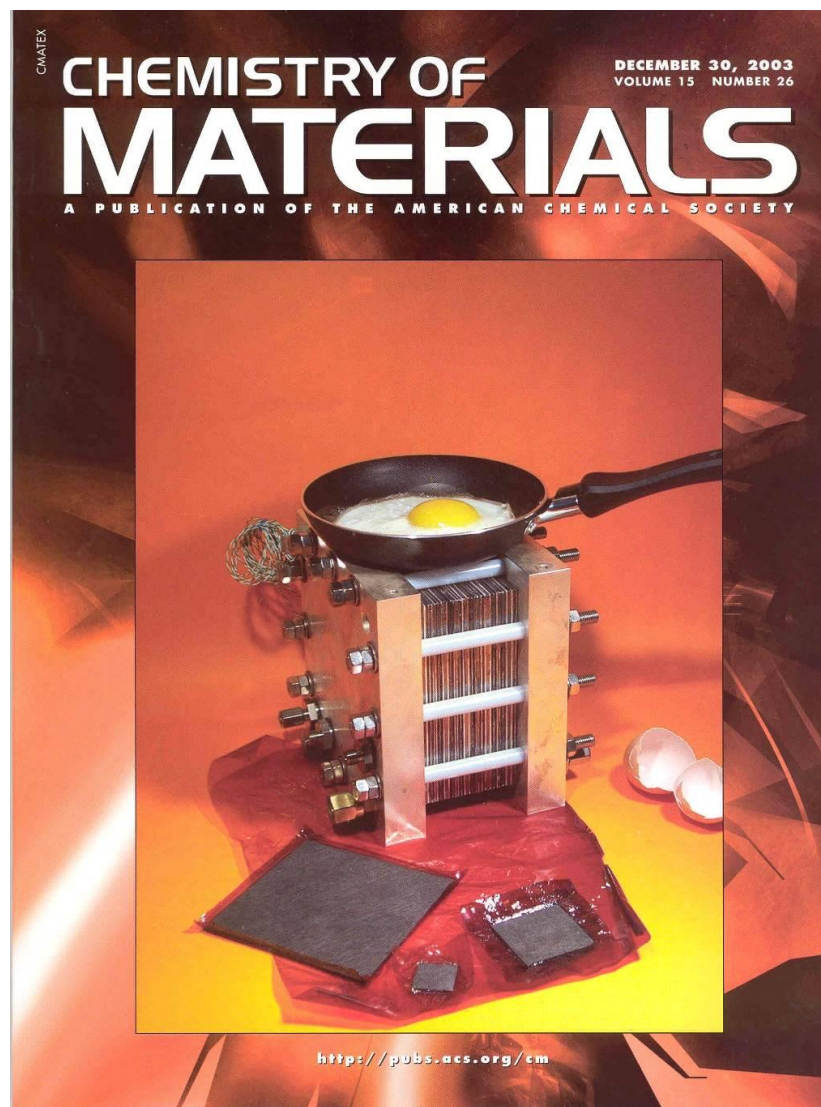


Thermoelectrics

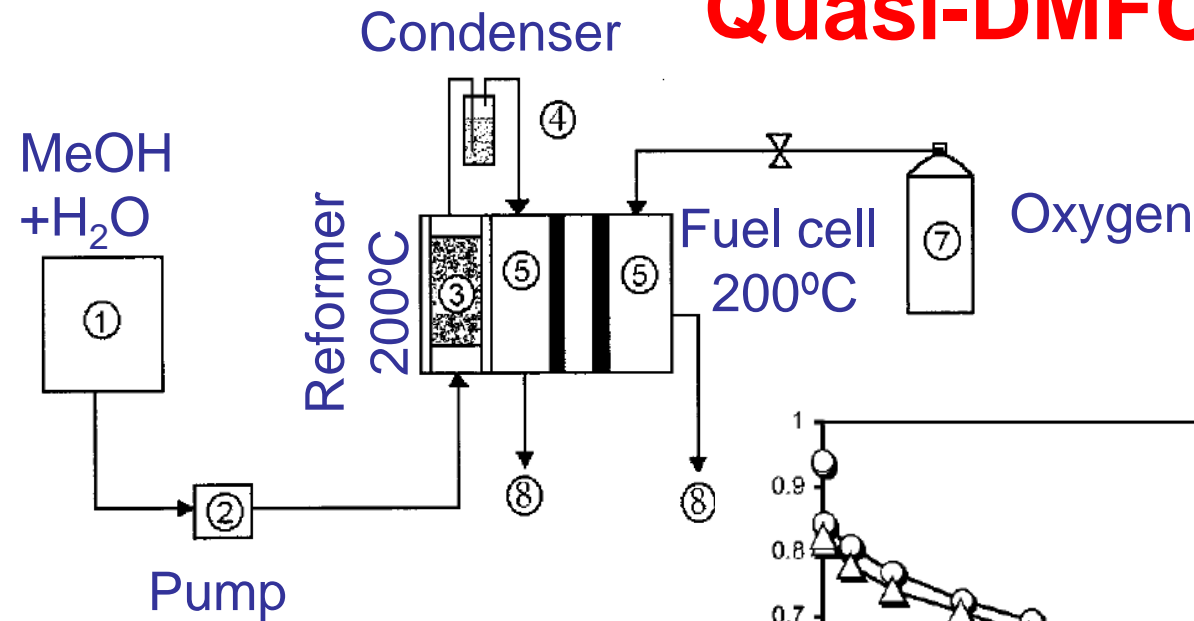
- Use of the Seebeck effect to generate electricity
- Conversion of waste heat from, e.g., solid oxide fuel cells
- Oxide materials for operation at 400-1000 °C
- Aim is to demonstrate a device with a conversion efficiency approaching 15-20%



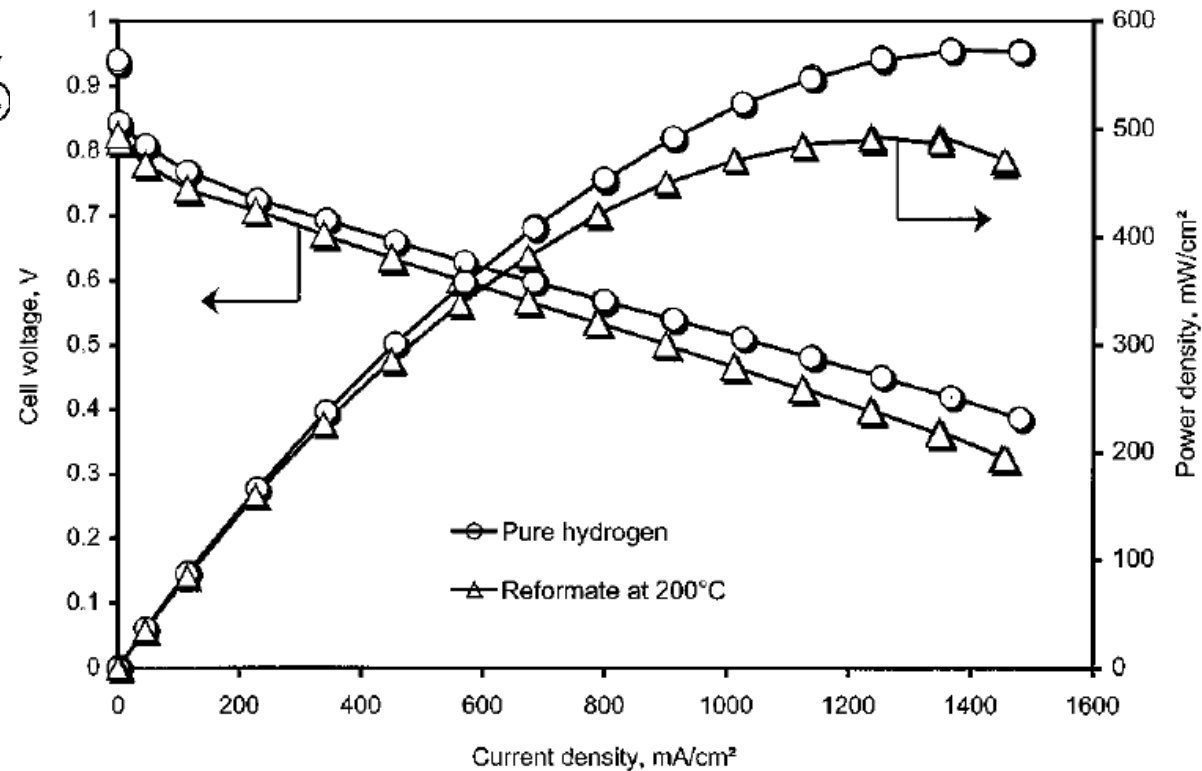
High temperature PEM fuel cells



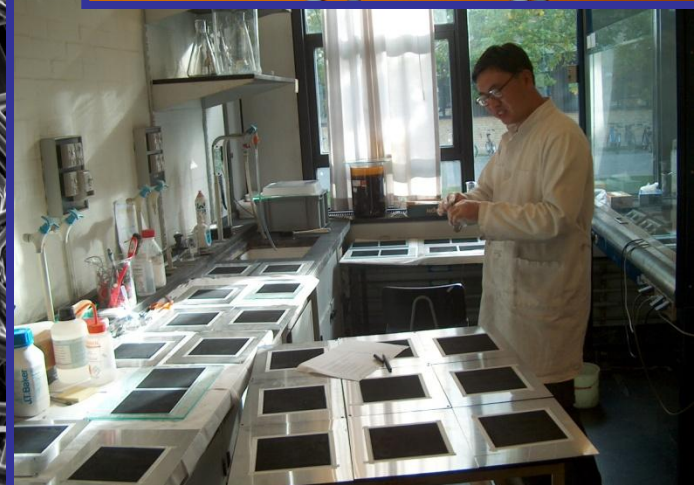
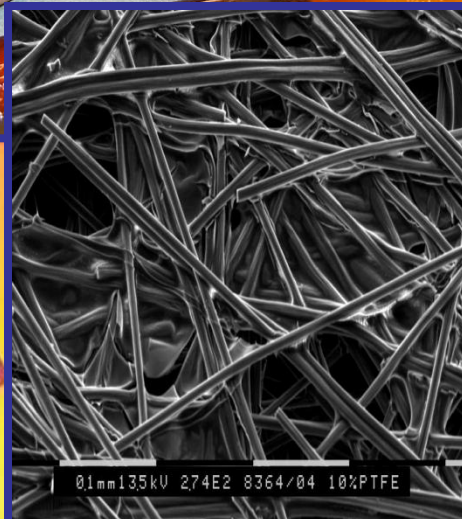
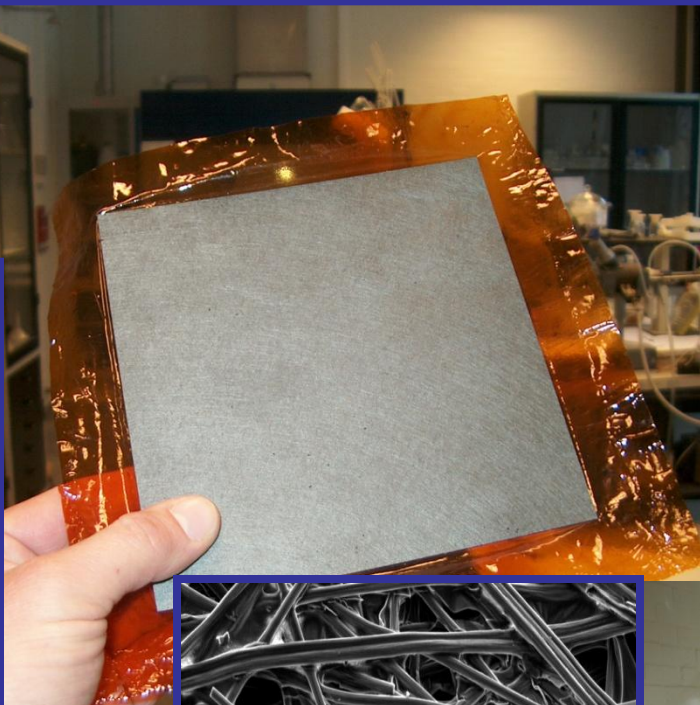
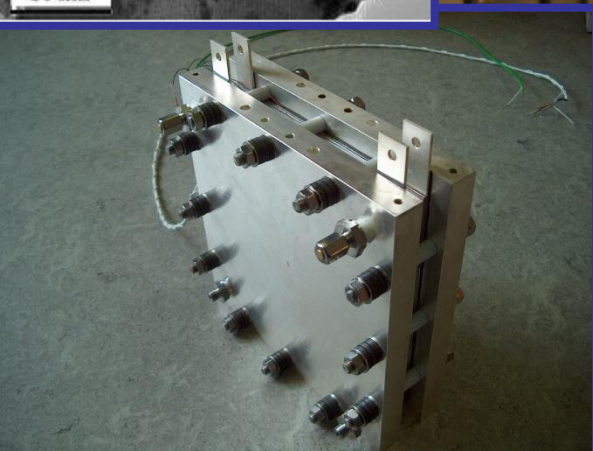
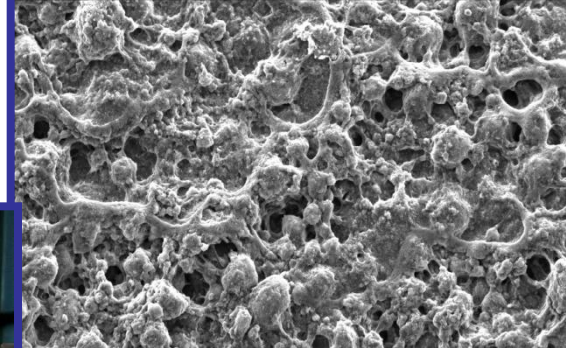
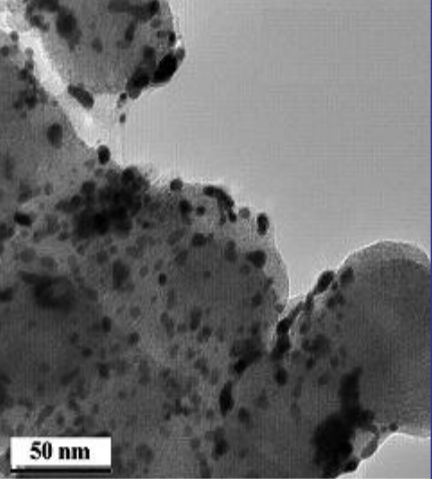
Quasi-DMFC



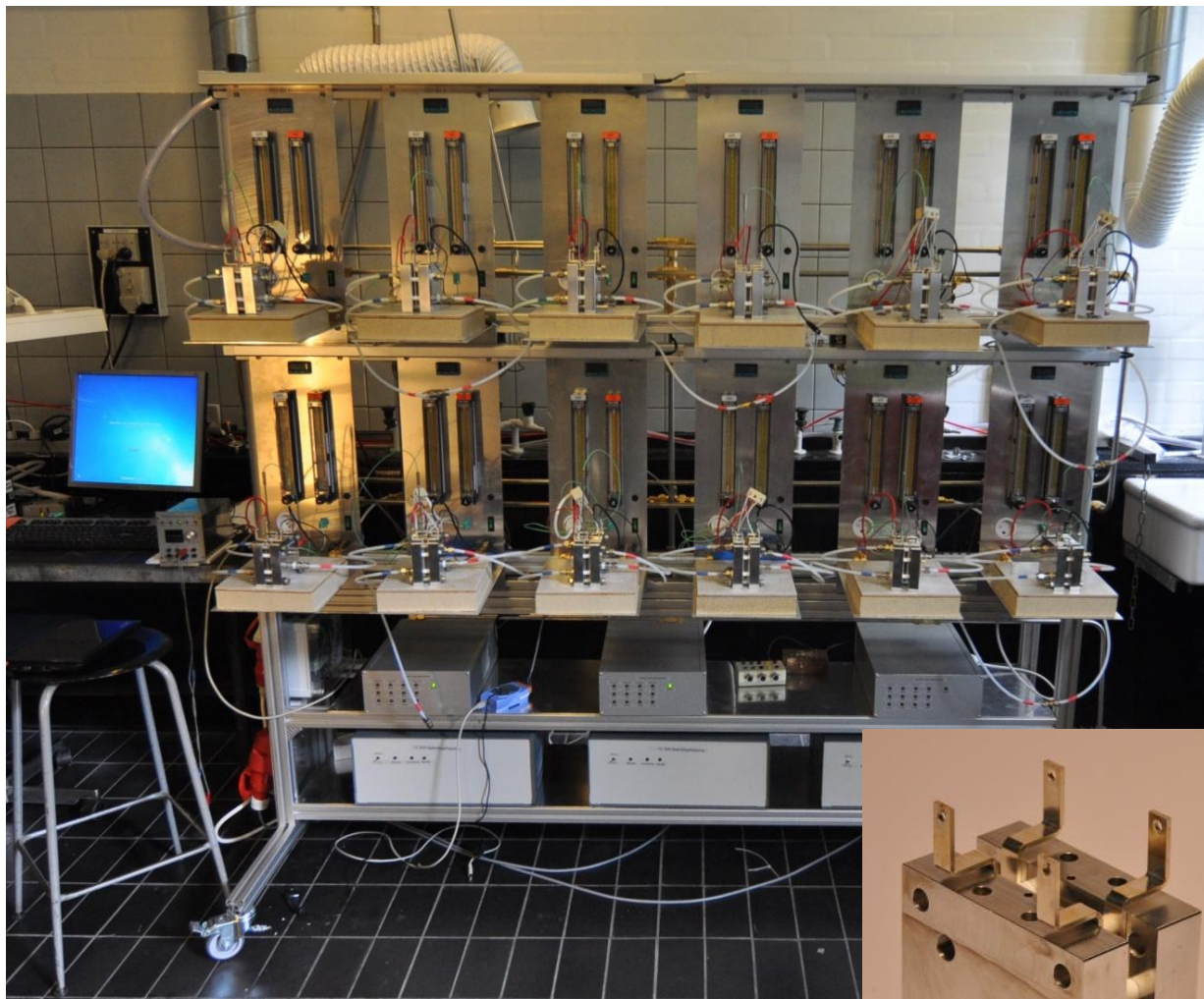
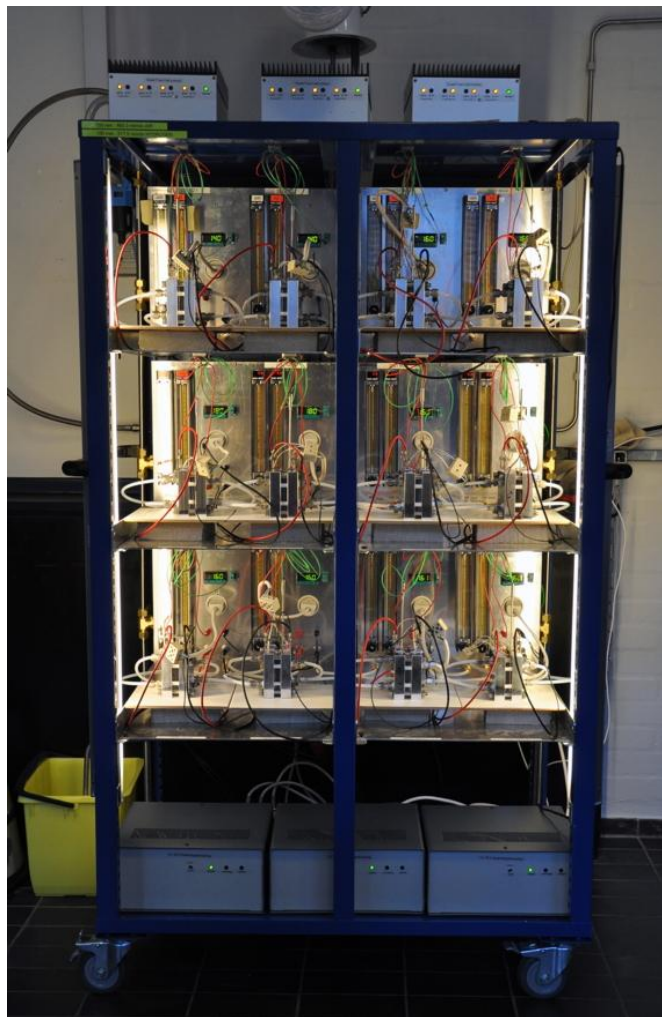
Li Qingfeng et al.
Electrochemical and
Solid-State Letters, **5** (6)
A125-A128 (2002)



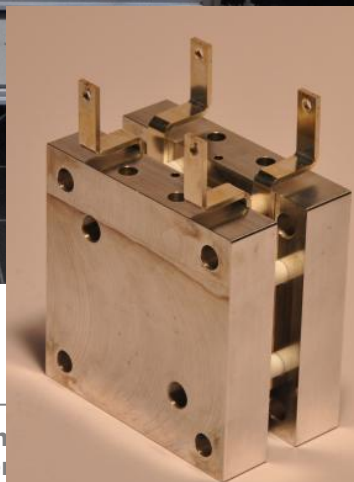
Activities at DTU



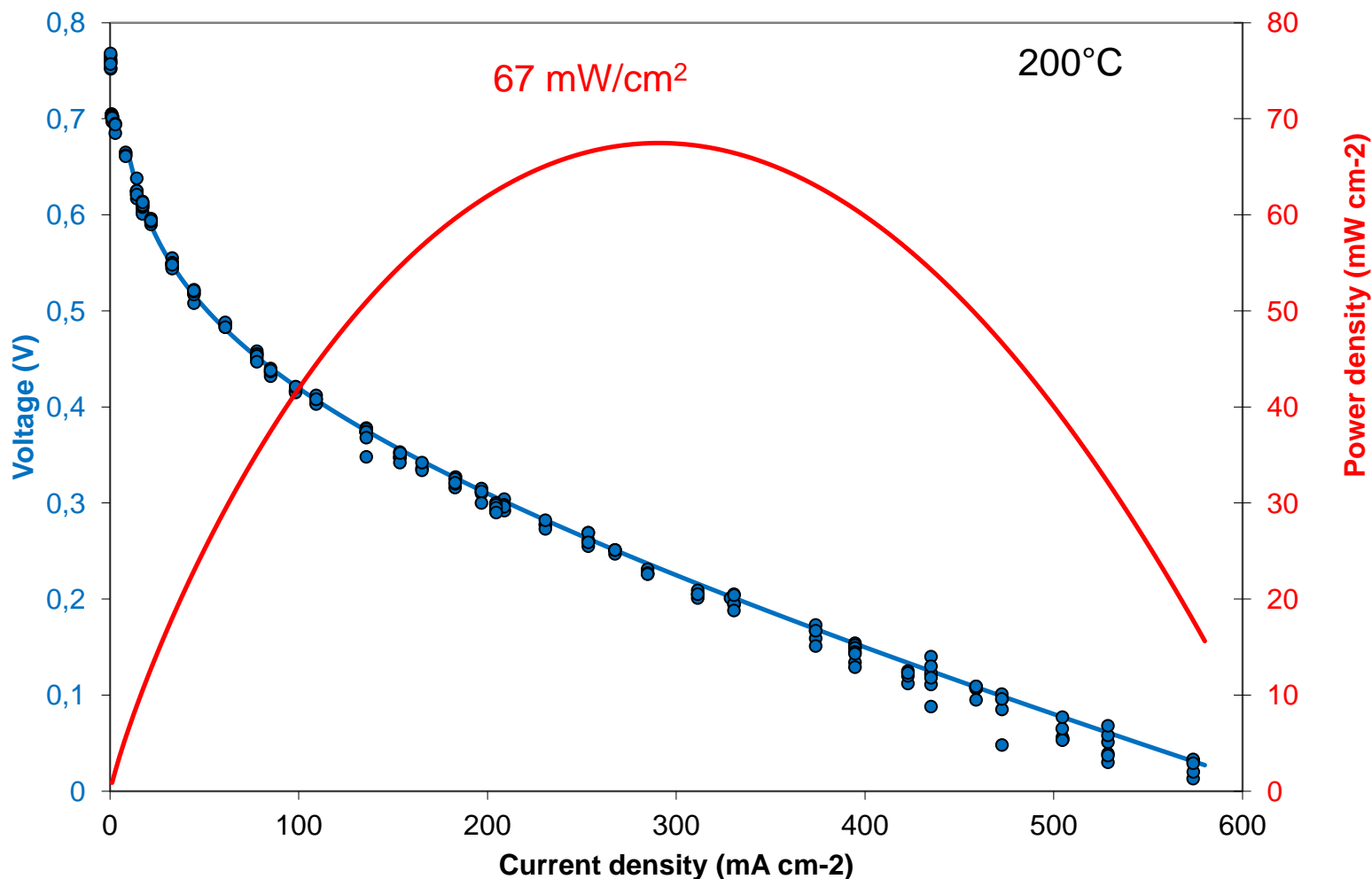
Single cell durability



2 X 12 channel test bench (cells 10 cm²)



Direct DME in HT-PEMFC

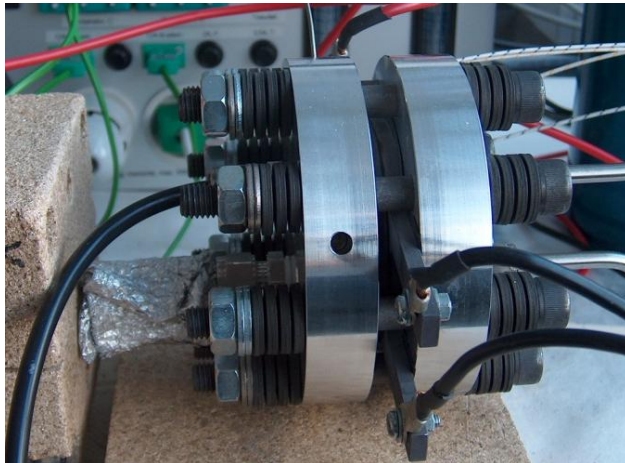


J. O. Jensen, A. Vassiliev, et al.
J. Power Sources **211** 173-176 (2012)

Polarization curves of a direct DME fuel cell based on acid doped PBI at 200°C.
Ambient pressure, air as oxidant.

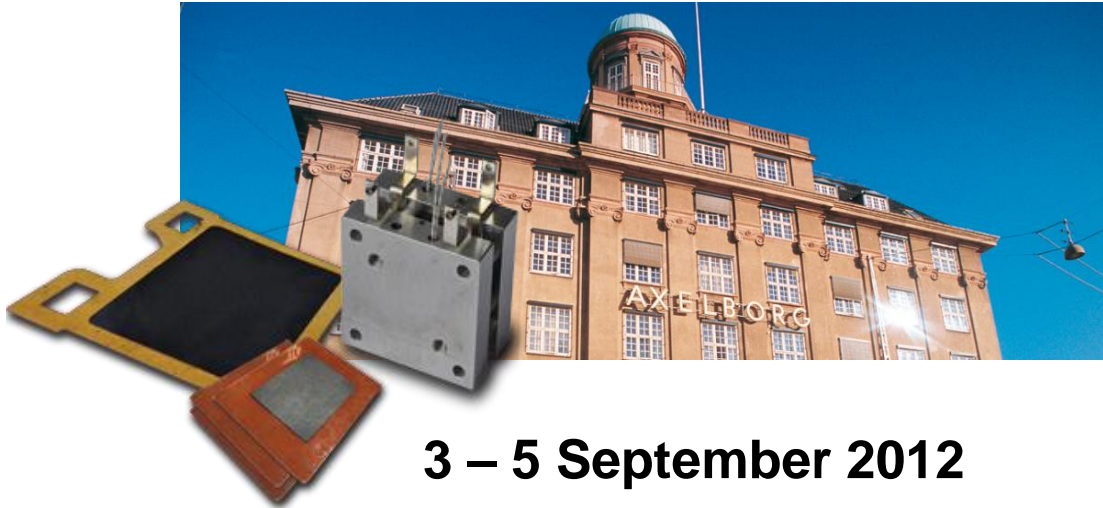
Electrolysis

- SOEC + CO₂ electrolysis
- HT-PEMEC >100°C
- AEC
- Inorg. proton conductors
200-400°C



CARISMA

2012



3 – 5 September 2012

3rd CARISMA International Conference on Medium and High Temperature Proton Exchange Membrane Fuel Cells

Venue: Axelborg, Copenhagen, Denmark

<http://carisma2012.com/>